Investigation of Resonant Ultra-Low Frequency Waves in Field Line Resonator and Ionospheric Alfvén Resonator at Low and Middle Latitudes

M. Alimaganbetov*, A.V. Streltsov
Embry-Riddle Aeronautical University, Physical Sciences Department,
Daytona Beach, FL, 32114-3900, USA.

Ultra-Low Frequency (ULF) waves play an important role in Earth's magnetosphere and ionosphere coupling. At high latitudes this coupling is conducted mostly by filed-aligned currents (FACs) carried by shear Alfvén waves, which belong to intermediate ULF MHD wave type. FACs actively participate in mechanisms of mass, momentum and energy exchange between magnetosphere and ionosphere. Therefore they are involved in numerous theoretical and experimental studies conducted during last 50 years.

Previous studies of ULF waves observed at high latitudes mostly agreed that main generation mechanism of large-amplitude Alfvén waves is an excitation of standing oscillations trapped inside one of two resonators. These are Field Line Resonator (FLR), with waves' typical eigenfrequencies in the range 0.9-10 mHz, or Ionospheric Alfvén Resonator (IAR) with eigenfrequencies in the range 0.1-10 Hz.

In this paper we focus on investigation of propagation of ULF waves in middle and low latitudes 35º-50º, on the L shells between 1.5 and 2.5. The main motivation is that they actively interact with ionosphere and cause plasma density disturbances. Specifically, we investigate which of the two resonators contain most part of electromagnetic energy in the ULF frequency range. This will determine where the energy is concentrated in the magnetosphere-ionosphere system, whether it is concentrated closer to ionosphere or inside IAR, or dissipated along the whole flux tube in FLR.

Our study proposes performing DFT over magnetic field data in order to determine dominant eigenfrequencies of ULF waves. Besides the main focus described above, we will also investigate required geomagnetic conditions observed during ULF waves propagation in both resonators. Data is taken mainly from sources operating at mid to low latitude. Stations such as ones of SAMBA array in Antarctica (latitudes around 62º-65º), and Chile (52º-55º); and satellite missions such as Communications/Navigation Outage Forecasting System (C/NOFS, at 25º) and COSMIC-2 (35º).

Along with our previous work on ULF waves observed at high latitudes, this work will enrich the understanding of ULF waves propagation and distribution mechanism in magnetosphere and ionosphere coupling. This, in turn, will allow to build stronger basis for space weather prediction in our future work.